CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 98 funds were provided for planning and design of a 45 acre pilot tidal wetland restoration project in Frank's Tract. CALFED FY 97 funds were provided for a Delta sediment transport and availability study and in-channel islands restoration demonstration projects (Little Tinsley, Webb Tract 3, 10 and 21).

- CALFED Water Quality Program.

ACTION 2: Restore Decker Island to tidal wetlands.

RATIONALE: Restoration of tidal wetlands on Decker Island will provide habitat along the Sacramento River for migrant Sacramento salmon, for delta smelt, and many other fishes. Some or all of the dredge spoils located on Port of Sacramento half of the island may have to be removed to return the island to tidal elevations.

ACTION 3: Restore seasonal wetlands on Twitchell Island.

RATIONALE: Restoration of seasonal wetlands on Twitchell Island will provide habitat for migratory birds.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 funds were provided for a tidal wetland and shaded riverine habitat demonstration project on Twitchell Island.

ACTION 4: Restore seasonal wetlands on Sherman Island.

RATIONALE: Restoration of seasonal wetlands on Sherman Island will provide habitat for migratory birds.

ACTION 5: Restore mid-channel islands in the Central and Western Delta.

RATIONALE: Mid-channel islands are important habitats that do not require acquisition of easements or land. Natural sediment transport processes can be used to create and maintain these habitats.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Use multiple techniques to protect existing habitats from boat wakes and use natural processes to create and maintain mid-channel habitats.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 funds were provided for a Delta sediment transport and availability study and in-channel islands restoration demonstration projects (Little Tinsley, Webb Tract 3, 10 and 21).

- CALFED Levee Program and Conveyance element.

TARGETED RESEARCH: Evaluate species utilization of tidal wetlands on Big Break.

RATIONALE: Big Break is a flooded Delta tract with a large expanse of shallow-water habitat. The region can serve as a reference site for species utilization of shallow-water habitat.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

Evaluate the utilization, residence time, and rearing of San Joaquin River salmon, delta smelt, and other native species.

GENERAL DELTA STAGE 1 ACTIONS

ACTION 1: Prevent introductions of exotic species throughout the Bay-Delta system through multiple strategies including: educating the public of harmful impacts, outlawing the sale or transportation of nuisance species .

RATIONALE: Introduced species have had a profound, adverse impact on the entire Bay-Delta watershed and its species.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 98 funds were provided to help

develop the California State Management Plan for Aquatic Nuisance Species.

ACTION 2: Develop and implement control strategies for nuisance aquatic plants in the Delta.

RATIONALE: Introduced plants such as water hyacinth, Egeria, and Elodia have taken over large areas of the Delta, clogging water diversion intakes, hampering navigation, and providing vegetative cover preferred by non-native, predatory fishes. Control of these plants will have benefits to multiple beneficial uses of the Delta and may create conditions more favorable to native species.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Ability to control nuisance aquatic plants.
- Extent to which non-native plants favor non-native fishes over natives.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

- California Department of Boating and Waterways hyacinth and Egeria control programs.

ACTION 3: Evaluate the feasibility of re-vegetating levees on the Sacramento River between Verona and Collinsville (also listed under Sacramento Basin actions).

RATIONALE: Current levee maintenance operations remove vegetation from levees to maintain channel capacities. Providing riparian habitat along the levees could benefit several wildlife species and provide valuable SRA habitat for aquatic species. Because riparian vegetation reduces channel capacity by increasing roughness, re-vegetation must proceed with improved flood management that reduces peak flows in the basin, or with setback levees that increase channel capacity.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate local water temperatures in levee reaches with restored riparian habitat versus levee reaches without riparian habitat.
- Compare the quantity and quality of aquatic and riparian habitat for levee reaches with restored riparian habitat versus levee reaches without riparian habitat.

TARGETED RESEARCH: Evaluate the feasibility of propagating special-status Delta plants species.

RATIONALE: There are numerous plants in the Delta, including many endemic species, which are listed as threatened, endangered or other special-status. In many cases the ecological requirements of the plants are unknown. Experimental propagation may identify the species' ecological requirements. It may be more feasible to reintroduce propagated plants rather than replicate the habitat requirements to encourage natural recruitment of the plants.

TARGETED RESEARCH/PILOT PROJECT: Develop a sediment budget (fine and coarse sediments) for the Delta. Monitor the effects of different flow events and other upstream events on sediment transfer to the Delta.

RATIONALE: Sediment supply to the Delta has decreased due to a loss of coarse sediment supply caused by dams, gravel mining, disconnection of floodplains, and water quality improvement actions. This loss of sediment may contribute to diminishment of Delta wetland habitats.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 funds were provided for a Delta sediment transport and availability study.

TARGETED RESEARCH/PILOT PROJECT: Determine the relationship between turbidity, primary productivity and potential eutrophication in the Bay and Delta.

RATIONALE: The relationship between turbidity, primary productivity and potential eutrophication in the Bay and Delta is not well understood. One hypothesis suggests that the decrease in turbidity from water quality improvement actions may increase light penetration, potentially leading to eutrophication.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 Restoration Coordination Program funds were provided for an assessment of the capacity of different Delta habitats to support the nutritional requirements of the invertebrate biota that sustain upper trophic level organisms. Tasks include sampling to measure the quantity and quality of organic matter available among the different habitats and the amount derived from the primary sources, describing the nutritional budgets in the Delta, and developing nutrient-phytoplankton dynamic models.

TARGETED RESEARCH: Evaluate the effectiveness of pulse flows from the San Joaquin River to improve salmon outmigration and to move juvenile salmon away from the South Delta pumps.

RATIONALE: There are conflicting hypotheses as to survival of outmigrant San Joaquin salmon. Current management emphasizes pulse flows intended to reduce entrainment in South Delta pumps. Conversely, pulse flows may reduce juvenile salmon survival rates by pushing them away from rearing areas too quickly.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Track indicator of salmon smolt survival through CWT (paired) experiments to assess baseline survival and survival after pulse flows.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

VAMP is experimenting with pulse flows.

TARGETED RESEARCH/PILOT PROJECT: Evaluate residence time of rearing and outmigration of San Joaquin River juvenile salmon.

RATIONALE: The relationship of habitat quality, quantity and distribution to the residence time of chinook salmon on the San Joaquin River is unknown. Determining impact of additional habitat to residence time will help determine to what extent habitat restoration will benefit salmon and how restoration efforts can be optimized.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Conduct a distribution survey.
- Conduct a habitat preference and utilization survey.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

- VAMP

TARGETED RESEARCH/PILOT PROJECT: Evaluate the need to screen small diversions in the Delta.

RATIONALE: Unlike in riverine environments where unscreened diversions may affect a large portion of fish, the benefit of screening small diversions throughout the Delta is unknown. An evaluation should be undertaken to identify diversion effects on species and locations in the Delta where screening small diversions is a high priority.

DRAFT SUISUN MARSH AND NORTH SAN FRANCISCO BAY STAGE 1 ACTIONS

SUISUN MARSH STAGE 1 ACTIONS

ACTION 1: Restore tidal wetlands in Suisun Marsh and Van Sickle Island.

RATIONALE: Restoration of tidal wetlands can provide habitat for native fishes, rare plants and wildlife.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate the effects of tidal marsh restoration on estuarine productivity.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 98 Restoration Coordination Program funds have been provided for planning for tidal restoration in Hill Slough West. FY 97 funds were also provided for restoration planning at the Martinez Regional Shoreline and for public

outreach to reduce the use and disposal of toxic pesticides in Suisun Bay.

ACTION 2: Develop and implement control strategies for nuisance marsh and upland plants in the Suisun Marsh and North Bay.

RATIONALE: Introduced plants such as *Lepidium latifolium*, and English cordgrass have invaded the marshes of North Bay and Suisun Bay, displacing native plants and animals. Control of these plants may create conditions more favorable to native species.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Ability to control nuisance plants.
- Extent to which non-native plants favor non-native fishes over natives.

TARGETED RESEARCH: Develop and implement a plan to analyze the mechanisms underlying the X2 relationships.

RATIONALE: Current management of the Bay-Delta system is based largely on a salinity standard (the "X2" standard). This standard is based on empirical relationships between various species of fish and invertebrates and X2 (or freshwater flow in the estuary). As with all empirical relationships, these are not very useful to predict how the system will respond after it has been altered by various actions in the Delta, including altered conveyance facilities. This implies a need to determine the underlying mechanisms of the X2 relationships so that the effectiveness of various actions in the Delta can be put in context with this ecosystem-level restorative measure.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

IEP Estuarine Ecology Team conducts ongoing studies of the relationship of fish and X2.

TARGETED RESEARCH: Study the effects of *Potamocorbula amurensis* on the foodweb and, as appropriate, develop and implement control strategies.

RATIONALE: *Potamocorbula* have decreased estuarine primary productivity, the effects of which have traveled throughout the foodweb, including upper trophic level species. Restoration of marshes may offset some of this lost productivity, but may not be great enough to overcome the effects of the clam unless its population abundance is reduced. There are presently no known, viable control methods for this species.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Extent to which *Potamocorbula* are limiting to restoration of native species.
- Extent to which effects of *Potamocorbula* can be overcome with other measures.
- Ability to control *Potamocorbula*.

NORTH BAY STAGE 1 ACTIONS

ACTION 1: Develop and implement a ballast water management program to halt the introduction of introduced species into the estuary.
RATIONALE: The single largest source of nuisance species in the Bay-Delta is from ship ballast water discharged to San Francisco Bay.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 funds were provided for an education and outreach program to prevent introduction of introduced species from ballast water.

ACTION 2: Acquire and restore floodplains and tidal marsh along the Napa/Sonoma Marsh.

RATIONALE: Protection, enhancement and restoration of North Bay tidal marsh and floodplain will benefit clapper rail, black rail, salt marsh harvest mouse and other salt marsh species. In high outflow years, Delta fishes also utilize North Bay habitats.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate species utilization of restored habitats.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 Restoration Coordination Program funds were provided for management support and assist in implementing restoration actions in the Sonoma Creek Watershed and the Napa River watershed.

ACTION 3: Acquire and restore floodplains and tidal marsh along the Petaluma Marsh.

RATIONALE: Protection, enhancement and restoration of North Bay tidal marsh and floodplain will benefit clapper rail, black rail, salt marsh harvest mouse and other salt marsh species. In high outflow years, Delta fishes also utilize North Bay habitats.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate species utilization of restored habitats.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 and 98 Restoration Coordination Program funds were provided for the acquisition, protection and restoration of 181 acres of tidal wetlands adjacent to the Petaluma River and for restoration planning on the Hamilton Wetland near Novato. Funds were also provided for Petaluma River watershed restoration planning.

ACTION 4: Acquire and restore floodplains and tidal marsh along the Napa River.

RATIONALE: Protection, enhancement and restoration of North Bay tidal marsh and floodplain will benefit clapper rail, black rail, salt marsh harvest mouse and other salt marsh species. In high outflow years, Delta fishes also utilize North Bay habitats.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate species utilization of restored habitats.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED FY 97 and 98 Restoration Coordination Program funds were provided for acquisition and restoration of over 1,000 acres of wetlands adjacent to the Napa River and for management support and assist in implementing restoration actions in the Sonoma Creek Watershed and the Napa River watershed.

ACTION 5: Develop and implement control strategies for nuisance marsh and upland plants in the Suisun Marsh and North Bay.

RATIONALE: Introduced plants such as *Lepidium latifolium*, and English cordgrass have invaded the marshes of North Bay and Suisun Bay, displacing native plants and animals. Control of these plants may create conditions more favorable to native species.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Ability to control nuisance aquatic plants.
- Extent to which non-native plants favor non-native fishes over natives.

TARGETED RESEARCH/PILOT PROJECT: Study the effects of *Potamocorbula amurensis* on the foodweb and, as appropriate, develop and implement control strategies.

RATIONALE: *Potamocorbula* have decreased estuarine primary productivity, the effects of which have traveled throughout the foodweb, including upper trophic level species. Restoration of marshes may offset some of this lost productivity, but may not be great enough to overcome the effects of the clam unless its population abundance is reduced. There are presently no known, viable control methods for this species.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Extent to which *Potamocorbula* are limiting to restoration of native species.
- Extent to which effects of *Potamocorbula* can be overcome with other measures.
- Ability to control *Potomocorbula*.

DRAFT SACRAMENTO RIVER BASIN STAGE 1 ACTIONS

SACRAMENTO RIVER BASIN DESCRIPTION

The Sacramento River and its tributaries are a vital component of the Bay-Delta ecosystem. As California's largest river, the Sacramento River provides the bulk of the Bay-Delta water supply, and it contributes approximately 80% of the inflow to the Delta. Despite human disturbances that have disrupted ecological processes in the basin, the Sacramento River and its tributaries continue to provide important spawning, rearing, nesting, and wintering habitat for a variety of species.

Factors most influencing the ecological health of tributaries in the Sacramento River Basin include:

1. Reductions in the magnitude, frequency, duration, and variability of river flows because of dam construction and diversions.

2. Reductions in the amount of coarse sediment available to create and maintain important aquatic and riparian habitat because of dam construction, aggregate mining in active river channels, and relatively narrow levees that increase shear stress applied to channel bed sediments.

3. Reductions in the amount of spawning and rearing habitat available to anadromous fish because of dams that block access to historical habitat ranges.

4. Reductions in the amount and contiguity of riparian habitat because of urban and agricultural encroachment and levee construction.

5. Elevated water temperatures because of dam construction, diversions, return flows, and the loss of riparian habitat.

6. Degradation of spawning and rearing habitat because of excessive loads of fine sediments and urban, industrial, and agricultural discharges of pollutants.

7. Loss of river-floodplain interactions because of levee construction.

8. Stranding of adult and juvenile anadromous and resident fish because of straying and the lack of hydraulic connectivity to river channels as flood waters recede.

9. Loss of seasonal wetlands because of levee construction and urbanization.

STAGE 1 APPROACH

Local watershed groups are active in many of the tributary watersheds of the upper Sacramento River basin. The ERP will work with these local watershed groups—as well as local, state and federal agency personnel—to implement and monitor Stage 1 actions.

Since many of the tributaries in the Sacramento River basin are regulated by large dams, it will be necessary to conduct targeted research and to monitor Stage 1 actions to determine the optimal combinations of flow and sediment that will best restore aquatic and riparian habitat in light of the regulated flow regime.

The primary species that will benefit from Stage 1 actions implemented in the upper Sacramento River basin are spring-run chinook salmon, fall-run chinook salmon, and steelhead trout. Both spring-run chinook salmon and steelhead trout have relatively stringent habitat requirements that upper basin tributaries can satisfy. Fall-run chinook salmon populations are distributed more widely throughout the Central Valley because of their less stringent habitat requirements. Populations of white and green sturgeon, American shad, striped bass and splittail will benefit primarily from actions implemented in lower Sacramento River Basin tributaries.

Stage 1 actions also focus on two tributaries that have been selected as demonstration streams: Clear Creek and Deer Creek. The objective for each demonstration stream is to fully restore the tributary within existing constraints (such as large

dams) so that each becomes a healthy, resilient haven of continuous riparian and aquatic habitat to optimize endemic plant and animal populations. Restoring these two tributaries into healthy riparian corridors during Stage 1 will help recover and maintain large populations of fish species to endure severe ecological conditions such as droughts. Both of these tributaries offer high-quality habitat in upstream reaches to satisfy the relatively stringent habitat requirements of spring-run chinook salmon and steelhead trout. Both creeks also provide habitat for fall-run chinook salmon in their lower reaches.

MAINSTEM SACRAMENTO RIVER STAGE 1 ACTIONS

ACTION 1: Protect, enhance and restore the meander belt between Red Bluff and Chico Landing.

RATIONALE: The Sacramento River still meanders freely for more than 50 miles between Red Bluff and Chico Landing, dynamically eroding existing banks and forming new banks. Meandering rivers help to sustain several critical ecological processes including gravel recruitment and transport, riparian succession, and the creation of diverse and valuable aquatic habitat such as cutbanks, pools, and spawning riffles. The SB 1086 planning process has developed the Upper Sacramento River Fisheries and Riparian Habitat Management Plan and the Sacramento River Conservation Area Handbook, which delineates a conservation area and provides guidelines for preserving and restoring riparian and aquatic habitat in the upper Sacramento River. Purchasing fee title, flood easements, or conservation easements on riparian lands within the conservation area will provide the river with room to meander and help to reduce flood damage by relocating economic activities and development from vulnerable floodplains.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Compare the quantity and quality of aquatic and riparian habitat for freely meandering river reaches and reaches protected by rip-rap.
- Determine the rate of gravel recruitment to the river from eroding banks.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

FY '97 and '98 CALFED Restoration Coordination Program funds have been provided to allow the acquisition of fee title or easement on several hundred acres of riparian land along the upper Sacramento River. Additional funds have been provided to actively restore riparian habitat on selected lands.

ACTION 2: In conjunction with the USACE and Reclamation Board Comprehensive Study, evaluate the feasibility of setting back levees on the Sacramento River between Chico Landing and Verona.

RATIONALE: The Army Corps of Engineers, in conjunction with DWR and the State Reclamation Board, is currently engaged in a comprehensive study to enhance flood management in the Central Valley by evaluating alternative flood management strategies such as floodplain storage. Setting back levees along the Sacramento River could reconnect the river with a portion of its floodplain, with the attendant ecological benefits, while simultaneously reducing flood risk. Setting back levees would enlarge the channel capacity to transport flood flows and provide floodplain storage, thereby reducing flood risk by reducing the pressure placed upon levees and by reducing peak flows.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

If it is feasible to setback levees, then:

- monitor and compare the amount and quality of aquatic and riparian habitat available in reaches narrowly confined by levees and reaches where the creek can meander within setback levees.
- monitor rates of gravel recruitment, transport, and retention in leveed vs. non-leveed reaches.
- compare flood stage levels and associated flood risk with historical levels for a given amount of inflow.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

The U.S. Army Corps of Engineers, California Reclamation Board and the Department of Water

Resources are conducting the Sacramento and San Joaquin River Basins Comprehensive Study to reduce flood damage and integrate ecosystem restoration. The measures that will be identified through the Comprehensive Study may have the potential to help meet or be compatible with the goals and objectives for the Ecosystem Restoration Program.

ACTION 3: Evaluate the feasibility of re-vegetating levees on the Sacramento River between Verona and Collinsville (also listed under Delta actions).

RATIONALE: Current levee maintenance operations remove vegetation from levees to maintain channel capacities. Providing riparian habitat along the levees could benefit several wildlife species and provide valuable SRA habitat for aquatic species. Because riparian vegetation reduces channel capacity by increasing roughness, re-vegetation must proceed with improved flood management that reduces peak flows in the basin, or with setback levees that increase channel capacity.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate local water temperatures in levee reaches with restored riparian habitat versus levee reaches without riparian habitat.
- Compare the quantity and quality of aquatic and riparian habitat for levee reaches with restored riparian habitat versus levee reaches without riparian habitat.

ACTION 4: Evaluate the need to screen all diversions smaller than 100 cfs on both the mainstem Sacramento River and selected tributaries.

RATIONALE: There are numerous small diversions of water from the Sacramento River and its tributaries. While many large diversions have fish screens to reduce the entrainment of fish, many small diversions are unscreened. The individual and cumulative losses of fish from these small diversions are unknown. Estimating the entrainment losses at small diversions, and comparing the effectiveness of fish screens with changes in the timing or location of small unscreened diversions will help to quantify and balance the benefits of potentially reduced entrainment with the costs of fish screening facilities. (CVPIA actions include screening all diversions on the Sacramento River greater than 250 cfs.)

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate the effectiveness of timing diversions to reduce impacts upon juvenile anadromous fish
- Study the loss of juvenile anadromous fish to entrainment in smaller diversions

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

FY '98 CALFED Restoration Coordination Program funds have been provided to study entrainment losses at twin diversions (20 cfs each) in which one diversion is screened and the other is unscreened.

ACTION 5: Evaluate and implement alternative structural and operational actions to reduce or prevent fish from straying into the Colusa Basin Drain with low habitat value.

RATIONALE: Agricultural return flows draining from the Colusa Drain into the Sacramento River can attract adult anadromous fish migrating upstream to spawn. There is no spawning habitat in the Colusa Drain, so adults that stray into the Colusa Drain subsequently become stranded and are lost to the spawning population. Creating a migration barrier will prevent adult anadromous fish from straying into the Drain.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Compare numbers of anadromous fish stranded in Colusa Drain before and after implementation of various alternatives.

DEER CREEK STAGE 1 ACTIONS

Deer Creek has the potential to be a demonstration stream, representative of northern Sacramento Valley tributaries that drain the Cascade and Sierra Nevada Ranges. Demonstration streams will be

selected for large-scale implementation of restoration actions to significantly restore ecological processes and resources while simultaneously testing restoration hypotheses as part of an adaptive management approach. The objective for demonstration streams is to fully restore the tributary within existing constraints (such as large dams) by accounting for all major stressors that affect the ecological health of the tributary. Lessons learned restoring Deer Creek will help the design and refinement of future restoration actions on the Deer Creek and other Bay-Delta tributaries.

Deer Creek has potential as a demonstration stream for several reasons. It has a relatively undeveloped watershed, which reduces human impacts upon the ecosystem. Deer Creek also provides habitat for a number of special-status species including, spring-run and fall-run chinook salmon and steelhead trout; indeed Deer Creek presents one of the best opportunities for recovering populations of spring-run chinook salmon because of the amount of holding and spawning habitat available in the upstream reaches. Deer Creek may also provide an opportunity to demonstrate the value of restoring habitat by restoring ecological processes rather than continued management intervention. Levees border the lower 10 miles of the creek channel, inhibiting channel meander, disrupting sediment transport, preventing floodplain inundation, and reducing riparian and aquatic habitat. Setting back or breaching levees could yield valuable information about restoring fluvial processes and associated habitats. Deer Creek may also demonstrate the benefits of alternative flood management if it is feasible to setback Deer Creek levees, thereby providing more floodplain storage of flood flows.

Such restoration of ecological processes will require broad public support from local stakeholders. CALFED will work with the local watershed conservancy and local landowners to pursue restoration opportunities in Deer Creek.

ACTION 1: Evaluate the feasibility of setting back levees along portions of Deer Creek to re-connect the creek channel with a portion of its floodplain and to allow the creak to meander more freely. Set back levees if feasible.

RATIONALE: In the interest of flood control, the Army Corps of Engineers channelized and constructed levees along Deer Creek in the 1940s. These levees, in addition to private levees, separate the creek channel from its floodplain, prevent the creek from meandering, and prevent the formation of valuable aquatic habitat associated with naturally meandering streams. The relatively narrow levees also concentrate flow and increase shear stress on the channel bed so that spawning gravels are often flushed from the creek channel during high flows. During the '97 floods, Deer Creek levees were breached in several places, which provided floodplain storage of flood flows that attenuated downstream flood peaks. Setting back levees along Deer Creek could improve aquatic and riparian habitat by providing the creek more room to meander, which helps to create diverse aquatic habitat such as cutbanks (valuable to rearing juvenile fish), pools (valuable to spring-run chinook salmon and steelhead trout holding through warm summer temperatures), and point bar deposits (valuable for colonization by riparian plant species). Setback levees could also increase the amount of floodplain available to store floodflows, helping to reduce downstream flood risk by reducing the height of flood peaks. It will be necessary to study the feasibility of setting back Deer Creek levees to determine the expense and potential impacts to flood management in the lower reaches. The feasibility study would also need to account for the need to purchase floodplain land or flood easements from private landowners in the vicinity of the setback levees.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- If it is feasible to setback levees, then monitor and compare the amount and quality of aquatic and riparian habitat available in reaches narrowly confined by levees and reaches where the creek can meander within setback levees.
- If it is feasible to setback levees, then monitor rates of gravel recruitment, transport, and retention in leveed vs. non-leveed reaches.
- If it is feasible to setback levees, then compare flood stage levels and associated flood risk with historical levels for a given amount of inflow.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

The Deer Creek Watershed Conservancy received FY 97 Funds to develop a Deer Creek watershed strategy.

There is a potential future linkage with the Comprehensive Study.

ACTION 2: Re-connect the creek channel with a portion of its floodplain by purchasing flood easements from willing sellers.

RATIONALE: Levees along Deer Creek were breached during the flood of 1997. Purchasing flood easements from willing sellers along Deer Creek could help reconnect the stream with a portion of its floodplain while simultaneously providing flood storage to attenuate downstream peaks.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- If it is feasible to re-connect the stream channel with a portion of its floodplain through setback levees or flood easements, then monitor the amount of floodplain storage and rates of water percolation to groundwater.
- Monitor the flow of nutrients from floodplain lands to the stream channel.
- Determine the extent to which anadromous fish species use floodplain land for refuge, spawning, or rearing.
- Monitor the level of stranding of adult and juvenile anadromous fish.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

The Deer Creek Watershed Conservancy received FY 97 Funds to develop a Deer Creek watershed strategy.

There is a potential future linkage with the Comprehensive Study.

ACTION 3: Acquire water from willing sellers or develop alternative water supplies to provide sufficient instream flows to allow the upstream migration of adult anadromous fish. (Note: this water will be part of the 100 TAF of water purchased to improve flows in the Sacramento and San Joaquin Basins.)

RATIONALE: In the past, water diversions from lower Deer Creek have de-watered the stream channel and prevented the upstream migration of adult anadromous fish. In recent years, landowners have worked with DFG and DWR to provide instream flows, in part by developing alternative water supplies for the water diverters. To ensure long-term water supplies that will provide adequate passage flows of suitable temperatures, it will be necessary to acquire water from willing sellers or to work with local diverters to develop alternative water supplies that will allow more water to stay in the channel.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Determine the flows necessary to provide fish passage over obstacles
- Evaluate the relationship between flows and water temperatures
- Determine the flows necessary to transport and cleanse spawning gravels.

ACTION 4: Protect and restore riparian habitat to create a continuous riparian corridor in the valley reach of Deer Creek.

RATIONALE: In addition to providing habitat for a variety of wildlife species, riparian buffers can help to trap fine sediments from reaching the stream channel. Riparian vegetation can also help reduce stream temperatures by providing shading, especially for pools that adult spring-run chinook salmon and steelhead trout use for holding during the summer. Riparian vegetation also helps create cutbanks that provide important rearing habitat for juvenile salmonids. Riparian vegetation also provides nutrients and woody debris to the creek channel, helping to stimulate food production and to provide diverse aquatic habitat.

Riparian vegetation can also help to retain stormwater runoff, helping to reduce peak flows in the channel and the concomitant flood risk to downstream reaches. Retention of stormwater runoff can also help increase the amount of water that percolates into groundwater aquifers, which